Shay 1880 to 1911

MAY, 1911

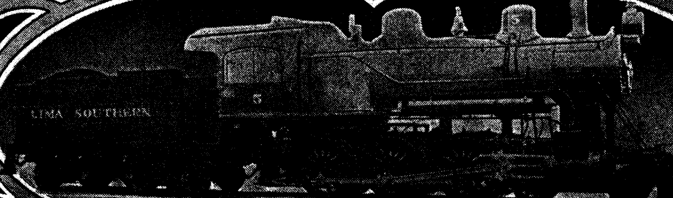
THE LOCOMOTIVE WORLD

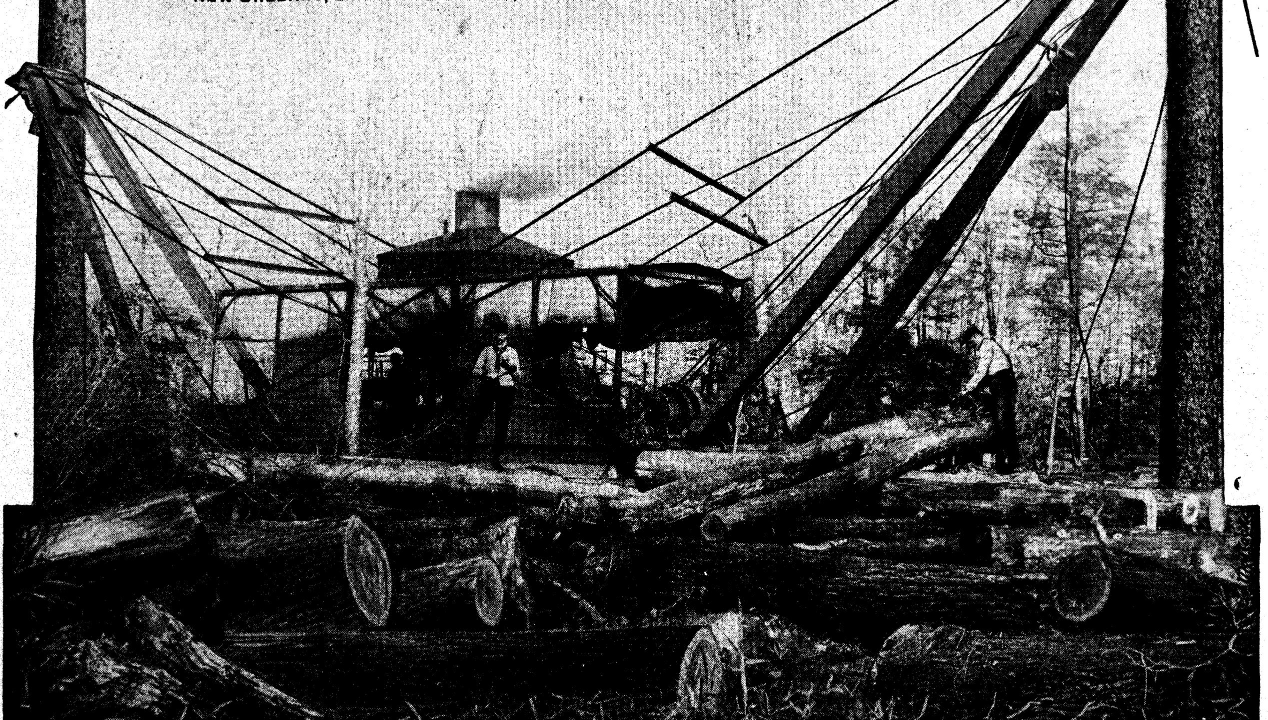
LOGGING · MINING

INDUSTRIAL & STANDARD RAILROAD

PLANTATION · MOTIVE POWER

BINGHAM CANYON SETTLEMENT, SHOWING COPPER BELT CURVE





THE LOCOMOTIVE WORLD

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THE LOCOMOTIVE WORLD.

PUBLISHED MONTHLY BY

THE FRANKLIN TYPE AND PRINTING COMPANY

H. C. HAMMACK, EDITOR

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Advertising rates fusnished upon application. Change n advertisements intended for a particular issue should reach the office of the Locomotive World no later than the 20th of the month prior to the date of issue. New advertisements requiring no proof can be received up to the 1st of the month of date of issue.

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LUBRICATION.

NEXT to purchasing a type of locomotive exactly suited to overcome conditions that confront the users of locomotives, maintenance seems to be the most important point which is left to be watched. All locomotives are alike when it comes to certain wear and tear, as they are similar in construction to all machinery—they will not last forever. However, much can be accomplished by simply the right kind of attention to the wearing parts of the locomotive machinery. Lubrication will do more to retard wear than anything else which the engineer can do to his locomotive. The object of lubrication is the reduction of friction between two surfaces working together. All metal surfaces which rub on each other or slide together must be separated by thin skin of oil or grease, or heating and cutting will take place and friction will be increased. One of the important features in lubrication is the selection of the proper lubricant. By long experience, it has been found that the best lubricant for locomotive cylinders is a mineral oil of a good body with a high flashing point. It is therefore necessary that owners and operators of locomotives obtain the best quality of cylinder oil which is on the market, as it is certainly very poor economy to try to save on such items as oil for cylinders. Animal or vegetable oils are not suitable in a cylinder on account of the fact that they decompose too rapidly, besides the stearic acid which may be formed will attack and eat the surfaces of the piston and cylinder. All cylinder oils should have a high fire test. It has been determined by experiments, that the flashing point should not be below 400 degrees Farenheit in any case, and a range from 500 to 600 degrees will be found to be better. There are many different kinds of cylinder oil on the market, but purchasers should insist on figures showing rigid tests before adopting any one kind. Another important factor with cylinder oil is to select an oil with high viscosity.

Viscosity is the property of being viscous—that is, sticky—tenancious. With a slow speed engine the viscosity is very necessary, but with fast speed engines the viscosity may be considerably lower and satisfactory results will be obtained.

Sight feed lubricators are used almost exclusively to oil the cylinders in our modern locomotives, and therefore, after the selection of the best grade of oil, the next thing which the engineer should turn his attention to is the proper handling and care of the lubricator to get the most satisfactory results. The engineer should fully understand the principles of operation of the lubricator, and while the majority of the engineers understand these principles, yet there are many men running locomotives who do not. In Volume One of "Practical Railroading" these principles are fully defined. A set of these books can be obtained from the Stanley Institute, Philadelphia, Pa.

The lubrication of driving journals and other bearings on the locomotive occupies another subject which the engineer should study very carefully. As we stated in the beginning of this article, proper lubrication will do more to retard wear and tear of parts than any other one thing. However, this not only means the use of the proper devices to apply the lubricant to the wearing surface, but it also means the adoption of the proper lubricant for the bearing to be lubricated. Oil has been found to be the most satisfactory for the cylinders and while grease and other lubricants have been tried for different journal bearings and wearing surfaces, yet beyond question the majority of locomotives in service today are using oil for all bearings. One of the serious objections to the use of grease as a lubricant is the increase of friction. The chief object of good lubrication is the reduction of friction to the minimum. The use of grease therefore, is detrimental to the gain in lubrication. In tests made it has been demonstrated that the use of grease instead of oil on driving journals, increased the friction per journal about 25 per cent. In the increasing of the internal friction of a locomotive the economy of the engine is being lowered, both in power and consumption of fuel. In conclusion, the study of lubrication is certainly an important one and one which the engineer cannot become too well versed.

WHEN A TRAIN IS BEHIND TIME.

When a train is behind time and keeps getting farther away from the schedule, the real cause of the delay is reported to be leaky tubes. The locomotive fails to make the necessary steam because the tubes are leaking.

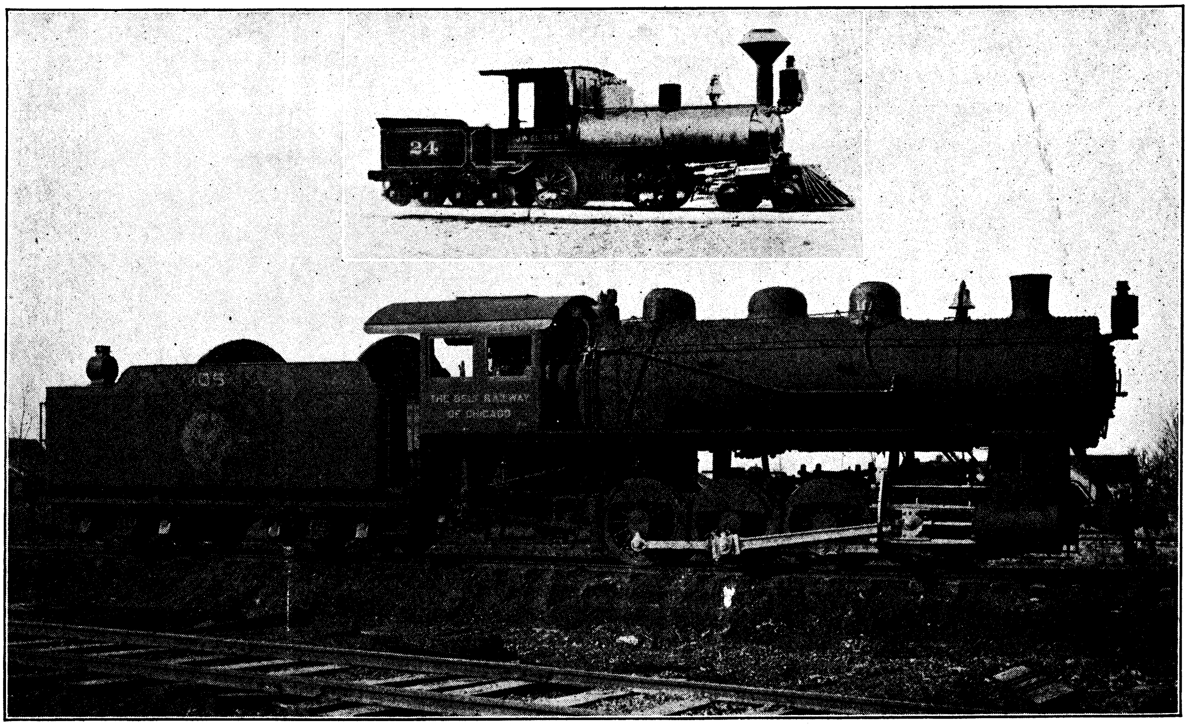
There are many causes that produce leaky flues, rough usage on the cinder pit being best known, but there is one fertile cause of this defect which receives too little attention. That is inferior material in the tubes. We hear complaints in all quarters that the material from which flues are made is not what it used to be, but the complaint is uttered cautiously as if it was a dangerous subject to stir up. Is there any mystery connected with the material employed in flue construction? Almost every master workman and boiler maker will testify that charcoal iron and good cold-drawn seamless steel tubes, are the only materials fit for boiler tubes, but some of them will whisper the suspicion that Bessemer steel is more frequently used than charcoal iron. To purchase Bessemer steel tubes instead of charcoal iron is one of the most expensive forms of expensive cheapness that railroad companies are guilty of. One engine disabled through failure due to inferior flues, sometimes incurs expense that would pay for several sets of good flues.

When inferior flues are purchased instead of flues made from good suitable material, there is something wrong, for there is a Railway Master Mechanics' Association standard for flue material that admits of no inferior substitute. The specifications for iron tubes says, "tubes are to be made of knobbled, hammered charcoal iron, lap-welded." The physical appearance re-quired of the tubes is given, and the weight for the different sizes. Certain tests are specified, which are very exacting and certain to insure good material, for nothing else would pass.

There are also specifications for steel tubes to be cold-drawn, seamless or made of open-hearth steel of the following composition: "Carbon,15 to 20; manganese, 45 too 55; sulphur, below .03; phosphorous, below .03." If that specification is adhered to, it will make a good tube, that will stand successfully the severe physical tests that are also specified. We hear constant complaints among boiler makers, that the tubes furnished, crack in bending. That will not happen, if the tubes are made of the material specified, and there is no difficulty in having the chemical and physicals tests made, for if a railroad company does not have a testing department, there are outside concerns always ready to undertake such work. Seamless cold-drawn steel tubes are generally what they are reputed to be. There was long a prejudice among railway master Mechanics against steel tubes, so they bought stuff that was called charcoal iron, but was Bessemer steel. A high mechanical official discussing "failure of flues," lately spoke of iron tubes that were not iron. He evidently knew what he was talking about.—*Railway and Locomotive Engineering.*

Thirty Two Years Progress.

JUST thirty-two years ago, The Lima Locomotive Works turned out its first locomotive. This was a 4-4-0-8 Type and was built for a lumberman in Northern Michigan by the name of J. W. Sloss. This was constructed for service on a logging tramway and was designed to work on wooden rail. This started the era of progress of this firm, as from the beginning it has been moving forward with a gradual development. A glance at the illustration "Thirty-two Years Progress" will enable all readers to form an opinion of its growth. Thirty-one years ago this firm constructed and shipped its first geared locomotive known as the Shay Patent



THIRTY-TWO YEARS PROGRESS

Geared Locomotive. This type of locomotive received its name from its inventor, Mr. E. Shay, a lumberman in Northern Michigan. It was constructed for the sole purpose of obtaining locomotive which could be operated more cheaply and successfully on crudely built tramroads and at the same time be adaptable to heavy grades, and sharp curves such as were found to exist in the large forests. This first locomotive, altho a very crude constructon, full of defects requiring many modifications, it demonstrated the possibility of effecting a revolution in the method of marketing timber, because it met the following requirements:

1st. The locomotive had a very short rigid wheel base, adapting it to sharp curves.

2nd. A longer flexible wheel base could be provided for than any other type of locomotive, adapting it to rough and uneven track, both laterally and vertically.

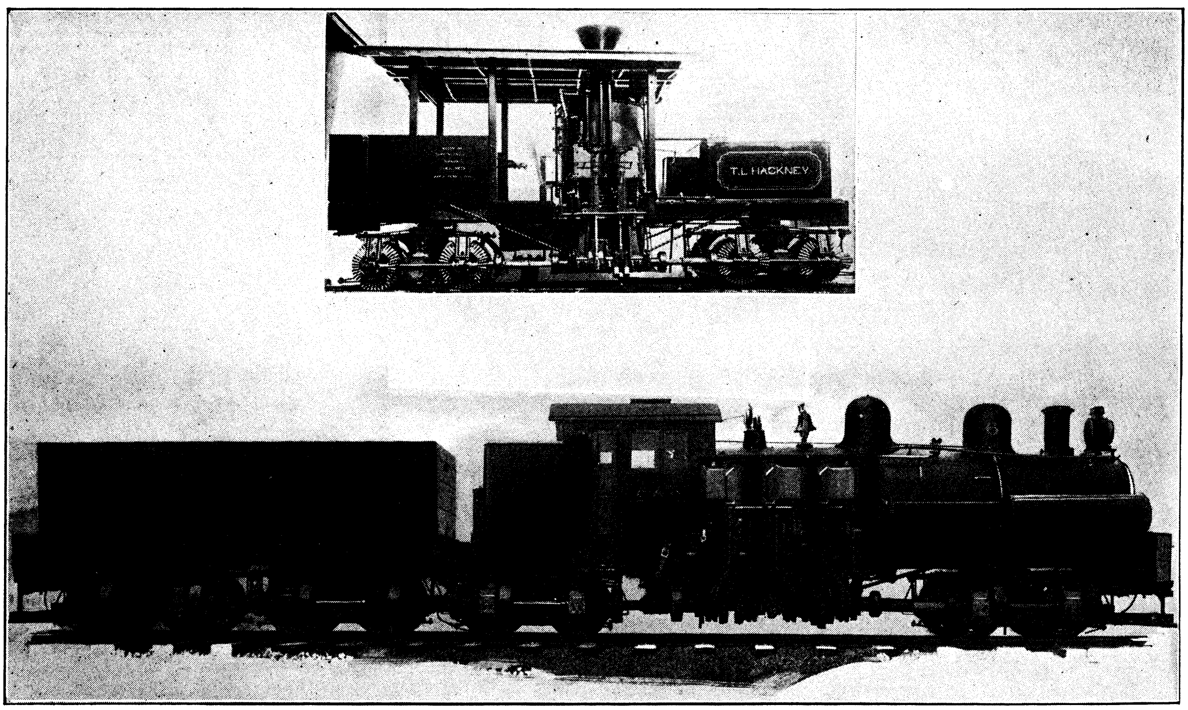
3rd. The weight was so well distributed that the engine could be operated on light rail, or wood track, under circumstances where it would be impossible to use any other type of locomotive.

4th. In most cases, the railways constructed for lumber operation, would be a temporary character, not warranting the expenditure of large sums of money for construction. The use of the Shay locomotive made it possible to meet this condition, and locomotives therefore almost entirely superseded those of horses and sleds, for the work.

5th. The entire weight of the locomotive was carried on driving wheels, making it all useful for adhesion, there being no dead weight due to separate tender, which is quite an advantage in heavy grade work.

6th. The locomotive was of such construction as to make it of moderate cost, yet withall, a durable machine, easily kept in repair and not requiring any very fine adjustments. The service and localities in which it was to be employed made this an imperative condition, the lumber operations being far from any machine shop facilities for making repairs of such nature as are usually required by other types of locomotives.

Altho the locomotive had been used for hauling lumber on logging railway as early as 1832, yet this was the first logging locomotive which was a success for handling the work in the woods. A great demand was at once created and the Lima Works turned its efforts towards perfecting and improving this special locomotive. Each year has brought many improvements to the Shay Patent Locomotive, which cannot be better expressed than by the illustration "Shay Locomotive 1880" - Shay Locomotive 1911". The Shay locomotive which unquestionably is the only all around success-



"SHAY LOCOMOTIVE 1880---SHAY LOCOMOTIVE 1911"

ful logging locomotive, has still another distinctive feature in that it is recognized the world over as being the best type of locomotive for heavy hauling on steep grades and sharp curves, yet to be constructed. It is in use on the mountainous branches of the Chesapeake & Ohio Railway, Mexico & Northwestern Railway, Canadian Pacific, Northern Pacific, Denver and Rio Grande, Great Western Railway of New South Wales, Australia, Chilean Longitudinal Railway of Chile, Arica & La Paz Railway & Transandine Railway of Chile, Peking-Kalgan Railway of China, Great Central Railway and Guatamala Northern Railway of Central America, Argentine Central Railway and Uintah Railway of Colorado, California Northwestern and San Pedro Los Angeles Pacific, Mill Valley & Mt. Tamalpais Scenic Railway of California, and many other noted steep grade roads.

Mr. C. O. Burge, M. Inst. C. E. London, England, in a recent article published in one of the leading Engineering papers of the country says:-

"In the opening of a branch of the great Western Railway of New South Wales, Australia, from Newnes Junction, on the main line between Sydney and Bathurst, to oil and coal properties at Newnes, one of the governing questions was the type of locomotive for operation on the steep grades and sharp curvature necessitated by the peculiar topography. After considerable study a selection

was made of locomotives of the Shay type, designed for great haulage power and flexibility on curves. These engines have now been in successful operation for two years on grades of 4 per cent combined with curvature of 17 deg. 30 min, which gives an equivalent resistance of a 4.4 per cent grade on tangent. It is believed to be the first use of the Shay engines in Australia. The branch leaves the main line about 87 miles long from Sydney and runs northerly 31 miles to Newnes, in the Wolgan Valley, the location of operations of the Commonwealth Oil Corporation, the builders built with a 4-ft. 8½-in. gauge, corresponding to that of the main line.

The district traversed is a portion of the high sandstone country, forming in this locality the main watershed of the state from north to south. It is undulating at the top, but falls by vertica detritus at the foot, which slopes more or less sharply to the lower country on the east and west. The sharp edge at the top is broken by many drainage ravines of considerable declivity. The main line of the Great Western Railway originally surmounted the watershed range by switchbacks east and west, but these are now cut out by tunnels. The steel declivity ofthe ravine, by which alone the branch could descend to the Wolgan Valley, necessitated the grades mentioned, the only alternative for easy grades being a series of apiral tunnels, the cost of which could not be justified. As it was, the study of the location of the descent was surrounded by difficulties, especially as distance has to be developed in a narrow gorge in order to obtain a grade practicable for smooth operation, and such that the detritus slope at the foot of the cliffs should be reached upon emerging into the open valley. This involved sharp curvature and tunneling."

The adoption of the Shay locomotive on this Mountainous Australian road goes to show that not only it is superior to the many other types of locomotives on the market, but that results are being obtained which cannot be accomplished satisfactorily by any other type of heavy grade locomotives. The adoption of this type of locomotive by the various roads has saved them many hundred thousands of dollars.

The geared locomotive only represents a portion of the out-put of the Lima Works. The large direct Connected Locomotives are now occupying much of its time. All classes of modern direct locomotives are being built; heavy freight and switcher locomotives for the large Trunk Railways, light locomotives for mines, furnaces, industrial plants, contractors, plantations, as well as all kinds of logging locomotives. An order of ten 24×28 0–8–0–8 Type Switchers was recently completed for the Chicago & Western Indiana Railway, and an order for twenty-three 20×26 0–6–0–8 Switchers has just been received from the Southern Railway.

The Lima Locomotive Works has an organization which is equal to any in the country. The capacity of this plant is one locomotive each working day, and as soon as the Half-Million-Dollar improvements which are nearing completion are placed in operation this capacity will be greatly increased. A standing invitation is hereby given to all locomotive users to call and inspect the Plant of the Lima Locomotive Works. It is the only large locomotive works in the Middle West, in fact, it is the second largest independent plant in the United States.

ESTIMATED AMOUNT OIL USED AS LOCOMOTIVE FUEL.

It is estimated that oil as locomotive fuel is rapidly on the increase. Statistics show that the consumption of fuel oil on the roads in 1909 amounted to 19,939,394 barrels, an increase of about 18 per cent. (3,050,324 barrels) over 1908. Oil as fuel has several good points in its favor over coal; besides being easier to use in the firebox it also does away largely with the smoke nuisance, danger from sparks, etc.

TRADE NOTES.

The San Antonio & Aransas Pass, mentioned in the Railway Age Gazette of March 10, as being in the market for 4 mogul locomotives, has ordered this equipment. The Baldwin Locomotive Works will build 3 of these locomotives, and the Lima Locomotive & Machine Company will build 1. The cylinders will be 19 in. x 26 in., and the total weight in working order will be 150,000 lbs.

WHEN IS A BRAKE OVERPOWERED?

BY WILL W. WOOD.

(Reprint from Locomotive Firemen and Enginemen's Magazine.)

EVER since we have had air brakes on our engines—and that's forever, to many of the younger engineers—official wrath has visited switch engineers, and freight engineers who do switch and use the air on the locomotive alone, on account of their having "used too high braking power," or "regularly using the emergency brake" while doing this work, resulting in braking the foundation-brake gear (brake rigging) on the engine or tender. Now, it's gotten to be a sort of three-cornered situation, with the engineers, the motive power department, and the general air-brake inspector, each occupying an individual angle. The motive power officials won't stand for the constantly recurring accidents; and the air-brake man must answer for the *leverage* and *pressure* side of the cases and the proper or improper understanding of air braking of the engineers.

The instructor says the whole trouble is due to misunderstanding on the parts of both the engineers and the officials; the engineers often have plausible, and sometimes very good excuses in their defense, and they don't know it, while the officials of the motive power department honestly believe the men are solely and wholly to blame. The instructor explained the situation the other day, in substance as follows, if not in his exact words:

Do you know (said he) what the one great problem is, that the air brake manufacturers have been for years, and are today, working unceasingly to solve? It is to devise a method of supplying an extremely high braking power that will stop a train in an extremely short distance *without skidding the wheels.* No locomotive nor car in this country today has nearly as powerful a brake as it should have, simply because of the danger of wheel skidding if the braking power should be raised to give any more resistance to wheel revolution. And the one evidence that any engine, tender or car is being braked too highly is in the skidding of the wheels; and *if the wheels do not skid*—no matter what else happens—*the braking power of the vehicle is not excessive.*

When a locomotive brake regularly "picks up" the wheels, it is caused by one or more of four things; either, the brake-pipe pressure is too high, or the leverage of the foundation brake is too great, or the engineer has a constant habit of applying the full or nearly full, braking power on a bad "rail," or the drawbar of the engine or tender may be too low or too high, causing a tilting and momentary lifting of some of the weight from a truck or pair of wheels. Of course, with the ideal brake none of these four causes would effect wheel skidding; but we haven't got the ideal brake yet. While wheel skidding is not the subject of this article, it has a relation thereto in reverse order; and don't neglect to arm yourself with the knowledge that in any and all circumstances, *if wheels do not skid*, there is not too much braking power available on that engine, or tender.

Who or what, then, should be blamed for the damages inflicted?

Here is the principle that covers the subject in a nutshell: When any part of the foundation-brake gear of a locomotive is permanently deflected or broken by the applied force of the brake, *and the wheels do not skid*, that part of the brake gear is too weak or not sufficiently supported to properly withstand the maximum braking power that should obtain on that locomotive.

The foregoing fact should not excuse an engineer from blame who regularly and persistently does his braking by using the emergency position of the brake valve; sometime, such kind of braking will tear down rigging that would have given much longer service under easier treatment. But the fact remains that the necessity for emergency applications must be admitted at certain times; and if the foundation gear will not stand without injury, the sudden application of a braking power properly proportioned to the weight of the braked wheels, then, *the foundation-brake gear is deficient*, and should be strengthened by a re-enforcement of metal, or support, or more perfect design.

On a locomotive pulling a three-car passenger train, new brake beams were applied to the tender; three were rather light beams of the skeleton type, while the fourth was a much stronger, I-section beam. At the time of installing these beams eight new brake shoes were supplied, and

to secure the proper piston travel it was necessary to "take up" the upper ends of the dead brake-beam levers; and this was wrong. It will be found that in different styles of brake beams the locations of pin holes for lever connections often vary as to the distance from the axle—or the plane of the wheel flanges. Therefore all brake beams on any one vehicle should be of the same style, for regularity in rod lengths; and when a new style of beam is installed rods of the correct lengths to suit these particular beams should be designed, with take-up holes in reserve at one end of each bottom rod, and with the upper ends of dead levers let clear out to the slack ends of their brackets; and with these conditions, to have comparatively short piston travel *with the instalment of partly worn brake shoes.* As it was, however, the new shoes were soon worn down and that tender was never again supplied with eight new brake shoes at one time; the three light brake beams lost their *camber* and began to show a deflection toward the axles; now, these two very natural events of friction and force increase the piston travel more than anything else, and in a short time the piston was striking the nonpressure brake cylinder head whenever a fairly strong application was made; and there was no way of shortening the piston travel, except by properly shortening the brake rods. The engineer made report of the failure of his tender brake, for it makes a big difference in the braking of a three-car train, to lose what should be a good tender brake; but the only result was in attracting attention to the three deflected brake beams, and he was censured *for using his brake too heavily.* It was believed that he had either been carrying too high a brake-pipe pressure or had been making emergency stops reogularly; and this belief in the face of the fact that there had been no skidding of wheels on locomotive nor cars, no injury to the brake beams on any other vehicle than the tender—and the I-beam on the tender showed no deflection whatever.

Depending upon evidence; it requires *skidding of wheels* to prove too high braking power; and it requires *shocks to passengers* or *car lading,* or *damaged draft gear,* to prove emergency braking; and even that evidence does not always prove the above causes, even in short passenger-train service

At a certain terminal where a large number of switch and transfer engines were employed, there one time developed an epidemic of breakage of "brake posts" in the driver-brake gear—the brake posts being the pins attached to the engine frame, from which the driver-brake levers are hung. Hardly any trouble of this kind had been experienced on those engines before, but now it was becoming too frequent on all of them; also, there were breakages of rods, equalizing levers, and other pins in the driver-brake rigging, and the responsibility was placed right square on the engineers; they were accused of doing "emergency" braking almost exclusively, while switching; and the yardmaster being particularly embarrassed by continual engine-brake failures, made such report himself. Of course it is not hard to catch an engineer using the emergency brake when he is switching a bunch of cars especially when there is "spotting" to do, and he is using air on the locomotive only; but as a fact, the engineers were doing less rough braking than ever. Anyhow, two or three of them got layed off on account of the trouble, yet there wasn't a single case of wheel skidding and flattening reported. However, it was remembered that about the time these breakages began, a supply of a diffierent kind of a driver-brake shoe was sent to the roundhouse foreman at Columbia, where all this happened, and upon orders he had equipped all of the switch and transfer engines with the new make of shoes; coincidentally it was noticed that at every brake application of fair power, the new shoes set up a rattling, clucking noise as disagreeable as the sound of saw filing; it seemed as though the irregularities in the contact surfaces of brake shoe and tire would engage (which is the real cause of frictional resistance), and then tear loose, and re-engage, and so in rapid sequence, and it was suggested that this destructive vibration should be blamed for the damage to the rigging. So they removed the newer style of driver-brake shoes and replaced the old kind; the noisy vibrations ceased, and the braking effects generally were then all that could be desired, and with no further damage to the foundation brake gear.

A matter that caused a good many old reliable freight and passenger engineers much trouble and aggravation, and reflected upon their capabilities, was another phase of the tender brake-

beam proposition, in connection with certain heavy freight and passenger engines equipped with the ET brake. Ever since air has been used it has been a common thing for cars and tenders to be completely designed except for any thought of the air brake, and to crowd the air brake apparatus on later, in whatever location remained opened, regardless of the standard requirements in the positions of brake pipe, angle and cut-out cocks, height of brake beams from the rails and their points of suspension, etc. On the tenders referred to the wheel base of the trucks had been designed unduly short, to meet certain requirements—turntable lengths, etc.—after which there was not sufficient room to place in-side-hung brake beams large and strong enough to withstand the braking power required by the weight of the tenders. Every scheme, except the right one, was tried by the right engine foreman in installing a brake rigging that would hold up. There was not space enough between the "spring plank" and wheels to place brake beams of proper strength, so the beams were lowered enough to clear beneath the spring plank; and that dropped the brake-beam levers (second class) so low that they would strike crossing planks and get torn off; and in certain of those cases the engineers were blamed "for careless inspection, permitting tender-brake gear to come down and drag." Next, they tried I-beams which were about the right strength for the power developed, originally, but trimmed at the most vital parts in order to place them; and the brake-beam levers were connected up at the most incorrect angles. The results in operation were bended brake beams, broken "brake heads" and fulcrums, and piston travels generally so long as to nearly or quite "bottom" the piston against the nonpressure cylinderhead; damage to the gear was being self-inflicted, and to no good purpose, for these tender brakes were inefficient; and every time the natural consequences developed the engineer was censured, either for too high braking power—feed valve or distributing valve safety-valve adjusted at too high pressure, as it was imagined—or *for making emergency applications* (which will not cause the ET brake to apply much if any *more violently* than will a heavy service application). The engine foreman didn't seem to understand the situation, and only one or two of the engineers directly interested were able to defend themselves from blame. Finaly the engine foreman decided to reduce the leverage of those tender brakes—sort of homeopathic remedy for a weak brake gear; and then the superintendent of motive power interfered and called the air-brake man into case, and the proper remedies were applied. The tender brake wheel-base was lengthened, and strong brake beams were installed and properly hung, and the whole system of rods and levers was correctly redesigned.

Note that during the time of this trouble there were no cases of slid-flat wheel on those tenders; so, at no time could *everpressure*, or *rough operation* be rightly charged.

Everything about the fondation-brake gear must be made strong enough to safely withstand the maximum braking power applied at emergency. But, if it is sufficintly strong, that doesn't mean that you should operate the brake heavily when lighter applications will do the work as well or better. Remember that there wouldn't be any thing wrong with an uncommonly high braking power, heavily applied, *if it wasn't for the undesirable results*, and if you are guilty, there will be evidence enough to honestly convict you—slid-flatwheels and broken draft-gear and car ladings, and maybe broken necks.

Say, there's nothing like being posted well to take care of your own defense, when a bunch of trouble is about to be unloaded on you.

HOW THEY BUILD A LOCOMOTIVE.

Writers of popular fiction have of late discovered the possibilities of construction work. As a result many recent magazine stories have contained more or less vivid descriptions of the work of engineers and contractors. In a current magazine the plot of a story hinges on the construction of a large dam. Judging from the description of this work, the authoress must have had as clear an idea of how a big construction job is handled as did the young women who visited the Baldwin locomotive works and then told how a locomotive was made. "You pour," she said, "a lot of sand into a lot of boxes, and you throw old stove lids and things into a furnace, and then you empty the molten stream into a hole in the sand and everybody yells and swears. Then you pour it out and let it cool and pound it, and then you put it in a thing that bores holes in it. Then you screw it together, and paint it, and put steam in it, and it goes splendidly, and they take it to a drafting room and make a blueprint of it. But one thing I forgot—they have to make a boiler. One man gets inside and one gets outside and they pound frightfully; and then they tie it to the other thing and you ought to see it go."—Eng. Contracting.

WHY AN ENGINE MOVES.

We have had several enquiries which involve the question, Why does an engine move? and for the sake of our correspondents we will endeavor to briefly give the reasons. Let us confine our attention to one side of an ordinary locomotive,with 20 x 24 ins. cylinders and 56 ins. driving wheels, and a boiler pressure of 200 lbs. The master mechanics' rule for the mean effective pressure in the cylinders is 85 per cent. of the boiler pressure, and in this case it amounts to 170 lbs.

This engine has a piston area of 314.16 sq. ins. and 170 lbs on each square inch imparts a total pressure to the piston of 53,407.2 lbs. but for the sake of facilitating the calculation, let us say 53,400 lbs. M. E. P. With piston at the back end of the cylinder and crank pin on back quarter, or just above it, the pull of the piston on on rod, cross-head and main rod reaches the pin. The wheel is a lever with fulcrum on the rail. This fulcrum changes from moment to moment as the wheel rolls along, and the point of contact between wheel and rail is called the instantaneous fulcrum, as the length of the lever or the operating part of the wheel above it changes momentarily. It is easy to see that if the crank pin is ever so little above the center line of the axle the pull of the main rod will turn the wheel and the engine will move forward. The effective pull, as we have seen, was 53,400 lbs., and this is applied to the wheel lever of maximum length when the crank pin is on the top quarter, for this is 40 ins. above the rail.

The force of 53,400 lbs. is therefore applied to the crank pin pulling it forward, but at the same time exactly this pressue is applied to the back cylinder cover, and the cylinders bolted to the frame carries this same force back to the axle box and tends to push box, axle, and indeed the whole engine backward. The center of the axle is, however, only 28 ins. above the rail. We have therefore the same force, viz., 53,400 lbs., applied to two levers of different lengths, one 40 ins. long and the other 28; that is in the proportion of 10 to 7. The moment of the force at the crank pin, about the instantaneous fulcrum at the rail is $53,400 \times 40 = 2,136,000$, and that at the axle is $53,400 \times 28 = 1,495,200$. The difference between these two moments is 640,800, in favor of the crank pin, and the engine moves forward.

On the back stroke the pressure on the piston and front cylinder cover is 53,400 lbs., and the moment of the force at the crank pin when on the lower quarter or 16 ins. above the rail, is 854,400. The moment of the force at the axle-center about the fulcrum on the rail, is 1,495,200. The thrusts on the pin tends to drive the pin, wheel and engine backward, while the pressure on the front cylinder-cover, frame and axle, tends to drive the engine ahead. The difference between these two moments is 640,800; the same as in the previous case, and the engine continues to move ahead.

On the back stroke the steam practically pulls the cylinder over the piston a distance of 2 ft., but the half circumference of the wheel is 7.33 ft., which is the distance the engine moves ahead. On the forward stroke the piston is pushed through the cylinder 2 ft., while the engine moves ahead 7.33 ft.

To picture the push of the piston as it acts on the crank pin when below the center line of the axle, let us suppose we have an ordinary wheelbarrow with wheel at the left hand side of the observer. Suppose that the two legs of the barrow have small wheels so that the whole can easily be pulled along without anyone touching the handles. Now tie a string to the vertical spoke on the lower half of the wheel. This is the one standing between the hub and the ground. If this string leading forward from the barrow be pulled, one would almost expect that the wheel would move in the direction of the hands of a clock, and that the wheelbarrow would move backward, and one would almost expect the spoke with the string attached would swing to the left.

As a matter of fact, neither wheel nor spoke move in this way, and any one who cares to prove it can easily do so with a toy cart or other small vehicle. If there is sufficient weight on the wheelbarrow to prevent slipping, a pull straight ahead on the string attached near the rim to the verticle spoke, will actually produce a motion of the wheel in a counter-clockwise direction, and the pull on the string becomes stronger in consequence, and the wheelbarrow will roll forward toward the man who is pulling on the string. This action is exactly opposite what occurs on the engine. Similar action to what takes place on an engine would be secured if the man got on the wheelbarrow and applied force to the vertical spoke below the centre line of the wheel.—*Railway & Locomotive Engineering.*

LOGGING IN THE APPALACHIANS.

In this department of the American Lumberman of April 8, an Appalachian operator asked for technical information regarding the operating of steam skidders in mountainous territory, The accompanying article it presented in response to that inquiry:

Boardman, N. C., April 11.

Editor American Lumberman:

Your article in issue of the 8th, regarding feasibility of skidder logging in the Appalachian mountains; having had considerable experience in logging in the Blue Ridge mountains in Tennessee and North Carolina, and being familiar with the topography, and also being conversant with skidder logging, would advise your party inquiring to stick to the methods in vogue in the mountains, unless he has some particular place where teams can not go, or where men can not ball-hoot the logs.

As a rule, timber in the Blue Ridge mouneains does not stand very thick as to quantity per acre, consequently a skidder, even if it had a full set, would not get the feetage that it should, and it would be a very infrequent thing to find a spot where a full set could be had, as the Appalachians are very much cut up, and the hollows are almost invariably very crooked, so that the usual skidding length of line of about 800 feet in most directions would meet with obstacles which would interfere with its work.

The greatest problem in mountain logging is the railroad construction work. Take a hollow that the longest skidding will be, say, a half-mile to the mouth of the hollow, the cheapest method is to skid the logs out with a team. When the length of the skid begins to go over a half-mile it is too far for economical team skidding, and then comes the question of putting the railroad up the hollow, or of building a slide to bring the logs out. Both railroad and slide building for heavy work cost approximately the same for construction, and if the grade can be made so it will not exceed 8 per cent, or even 10 per cent in spots, railroad construction is by far the most satisfactory, as the camp is almost always located at the end of the railroad, and the closer to the work the better. If the grade shows over 8 per cent, and in occasional cases of the very rough country, the slide should be put in from as far as the railroad can not be built with safety, if necessary to make the team haul in skidding as short as possible. Once the logs are landed alongside the railroad the trouble is about over.

Considering a skidder set as forty acres for mountain logging, the railroad would have to be built to get the skidder in and the logs out, and the skidder would have to be set at the track. Now if the machine could get a free and unobstructed sweep down hill for 800 feet in every direction it could handle that setting economically enough; but if the slope of the mountain happened to run, say, 1,500 feet away from the machine there would be still left 700 feet of timber which the machine could not get, and for which teams would have to be used. On account of the cut up nature of the country in the Blue Ridge I have seen very few places where a skidder could do rapid and economical work.

On a fairly largely operation I have often thought a medium or light weight machine might be a money saver at times; for instance, there is occasionally found a pocket in the mountains below the grade of the railroad which is almost impossible to get the logs out of with teams except at a prohibitive figure, and which a machine could handle readily. At other times, where hemlock and pine are found, occasionally where two creeks come together will be found a flat, usually rather soft, and generally very heavily timbered, and sometimes a 10 to 20-acre set could be had for a machine at a profit. If a company cares to go to the expense of keeping a machine, at times like these it will be found very handy, but for regular and steady work in the mountains it would not do for a company to depend upon the machines for their logs unless they expected to leave the bulk of the timber in the woods, being where machines could not get at it.

The best method in my estimation is to use Shay geared engines and railroad on grades up to, say, 8 per cent, building the camp at the head of the track. If the skidding is not too far from the head of the track bring the logs in with teams; if farther than teaming distance, either build slide balance of the way or put in light rail narrow gage track and use on it a light car with good brake, to come down loaded with

a man on the brake and after unloading hauled back with a mule or horse, either way is good and the last probably the cheapest of construction and operation if the grade does not get entirely too heavy.

Rail plenty heavy for equipment should be used on the railroad, and if 40,000 feet or more a day is to be handled a Barnhart loader should be on the log train.

Another feature which I think is very often neglected in mountain work is to have the slide or railroad line up the hollows properly surveyed and the levels taken before constructing, as the slight expense will be saved many times in the avoidance of bad obstructions, and the much better alignment of the track, and the proper division of cuts and fills.

I trust that your correspondent may find the above of service.

HOWARD WATERS.

(Difficulties involved in Appalachian logging are of greater variety and of more serious character than in most other sections of the United States. These difficulties delayed for some the years the development of the less accessible sections of the Appalachians and it was only when superior logging knowledge and engineering skill were brought into execution that the fine timber now manufactured throughout that section was made available to market.

The inquiring operator being an Appalachian lumberman doubtless is familiar with many methods employed in the Appalachians. In this instance he asked for information about steam skidders only The objections to the use of the ordinary skidder in Appalachian loggiing is that the country is so rough that not enough ''feetage'' is obtained at each setting to make the use of a skidder profitable. This situation is met in a variety of ways in Appalachian logging.

The overhead skidder has been utilized to some extent in the Appalachians to get out timber that apparently could not have been obtained by any other method. Under conditions such as described by the correspondent in which the stumpage is not heavy and in which the settings, if an ordinary skidder were used, would be so frequent as to make its use unprofitable, and when the territory is too small or the standing too limited for a railroad, the logs may be snaked into the overhead skidder's right of way, usually only a short distance, by teams and hauled by means of the skidder to the railroad.

This method has been utilized in a case in which the dividing line of the operator's holdings fell on the opposite side of a mountain from that on which the greater part of his holdings lay. Of course he could and did build a main line railroad up through the center of his main holdings, but that did not reach or make available the timber on the opposite or ''outer'' side of the mountain. Ordinarily the road would, and in this case it did, end at practically the highest point on the holdings. Accordingly one end of a cable was anchored at a point at the end of the railroad and the other end of the cable was anchored down in the valley in the outer side of the mountain. All timber on the other side of the mountain was hauled down to the cableway of the overhead skidder, a donkey engine was stationed at the top of the mountain at the junction of the railroad and the trolley line and the logs were hauled up to a rollway at that point.

Cableway skidding in mountain logging is recommended for use when the ground is rough, steep or broken with cliffs, gorges or canyons, or is covered with fallen timber, underbrush or other encumbrances; and where the stumpage is more than 8,000 feet to the acre regardless of ground conditions. In fact the cableway skidder apparently may be utilized to bring in timber otherwise utterly inaccessible. All that is required is a clear ''air space'' for streching the distance up to 1,600 feet. Being operated in the air, carrying tue logs partly or wholly suspended, the condition of the surface of the ground has little influence. The drum for pulling the carriage is back geared for the heavy load, and the outhaul rope for pulling the carriage back to the rollway is high geared so as to reduce to a minimum the waste of time in returning for a load.

The number of logs carried in each load or trip of the cable carriage of course varies with their size, but from six to twelve have been carried on such a cableway in spruce logging, logs of that wood usually averaging small.—*Courtesies of American Lumberman.*

The Southern Railway has ordered 50 locomotives from the Baldwin Locomotives Works, 23 switching locomotives from the Lima Locomotive & Machine Company, and 20 passenger locomotives from the American Locomotive Company.

OILING LOCOMOTIVE TIRES.

A train passing a curve slowly makes a squeaking noise caused by the wheels grinding against the rails and if the train passes at high speed the grinding action is still there although one cannot hear the noise. This is destructive practice as the wheels and rails grind each other and the locomotive has to furnish the power for it. To avoid these losses some roads are overcoming this friction at the locomotives by greasing the flanges of the driving wheels, with very good results.

The Wabash-Pittsburg Terminal R. R. has given this matter careful consideration. On the West Side belt tracks in Pittsburg, with their sharp curves, the driving wheel tires suffered greatly until it was found that the life of the tires could be tripled or quadrupled, by oiling the flanges. Flange oilers have been tried for years but without much success until recently, when it was discovered that a heavy asphaltum oil conveyed from the cab to the wheel flanges by a jet of steam becomes sticky so that it can be applied to the flanges without spreading to the tread of the wheel . This road has since equipped many of their engines with this device and the saving effected is enormous, if you consider the cost of re-turning the tires, the expense of remounting the wheels, the loss in metal turned off the tread, the loss in revenue during the time the engine is standing in the shop, and lastly, that the rails are saved as much as the tires. *—From a paper by O. Stucki, "Achievements in Railroading," before the Engineers' Society of Western Pennsylvania, Mechanical Section, "Proceedings" for March 1911.*

NEW TUBE TONNAGE RECORD.

For the month of March the Detroit Seamless Steel Tubes Company established a new production record, the tonnage manufactured being 24 per cent larger than in any previous month in its history. A large percentage of the production of this company is used by the railroads for locomotive flues, and the product for the month of March, if placed end to enp, would represent a tube about 175 miles long. This looks promising for a return of prosperity in the iron and steel industry.*—Detroit Journal.*

THE PRODUCTION OF IRON ORE IN 1909 AND 1910.

In response to telegraphic requests by the Director of the United States Geological Survey at the close of 1910, reports and estimates of iron ore production for 1909 and 1910 were promptly sent by 18 of the largest iron mining companies, whose combined output represents about 75 per cent, of the total producion of the United States. From these returns it is estimated by E. F. Burchard of the Survey that the iron ore produced in 1909, not including stocks left at the mines, was between 51,000,000 and 52,500,000 gross tons. Of this quantity 45,500,000 to 46,500,000 tons was red hematite, the remainder consisting of brown hematite, magnetite and carbonate ores in the order named. The returns for 1910 indicate that between 52,500,000 and 54,000,000 gross tons of iron ore was produced, of which between 47,000,000 and 48,000,000 tons was red hematite.

The following tables afford a comparison of the quantities of iron ore produced in the years 1907 and 1908, with the estimates of production in 1909 and 1910; and also a comparison between the quantities of iron ore produced and the pig iron manufactured. The data on the pig iron are taken from the annual reports of the American Iron and Steel Association, with the exception of those for 1910, which are estimated:

Years—Gross tons	Iron Ore	Pig Iron
1907	51,720,619	25,781,261
1908	35,983,336	15,936,018
1909	*51,750,000	25,795,471
1910	*53,250,000	*27,099,422

*Estimated.

STOPPING A TRAIN.

According to Signal Engineer J. A. Peabody, of the Chicago & Northwestern railway, who investigated the matter on his own line, the cost of stopping a train of 530 tons and returning to a speed of fifty miles an hour is 42 cents.

The cost of stopping a two-thousand-ton train from thirty-five miles an hour is $1.

The officials of another road estimate each stop of a six-car passenger train from forty-five miles an hour at 35 cents, and for a 1,500-ton train from fifteen miles an hour at 56 cents.

The time lost for making a stop on a level, straight track has been estimated at 145 seconds.*—Buffalo News.*

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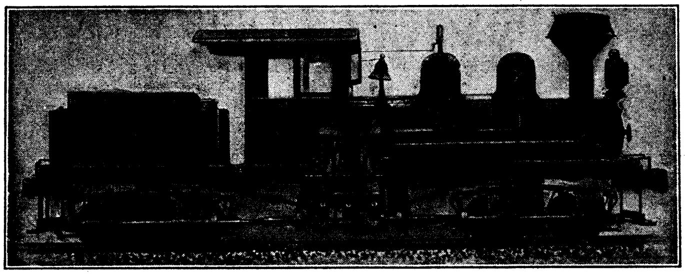

A PARTIAL LIST

	TONAGE	TYPE	GAUGE	LOCATION	REFERENCE NO
1	10	Shay	56½″	Arkansas	113
1	13	Shay	56½″	Georgia	0829
1	15	Shay	42 ″	Mississippi	0810
1	15	Shay	56½″	South Carolina	0818
1	17	Shay	56½″	South Carolina	0819
1	18	Shay	56½″	Tennessee	114
1	18	Shay	56½″	Florida	110
1	18	Shay	36 ″	Tennessee	086
1	28	Shay	56½″	Arkansas	0828
1	30	Shay	36 ″	New York	101
1	33	Shay	56½″	West Virginia	0825
1	33	Shay	56½″	New York	111
1	37	Shay	56½″	Michigan	0826
1	42	Shay	56½″	Mississippi	103
1	55	Shay	56½″	New Mexico	0832
1	65	Shay	56½″	New Mexico	083
1	65	Shay	56½″	New Mexico	0831
1	30	4 Wheel	56½″	Mississippi	0833
1	30	Mogul	56½″	Mississippi	112
1	35	Mogul	56½″	Mississippi	089

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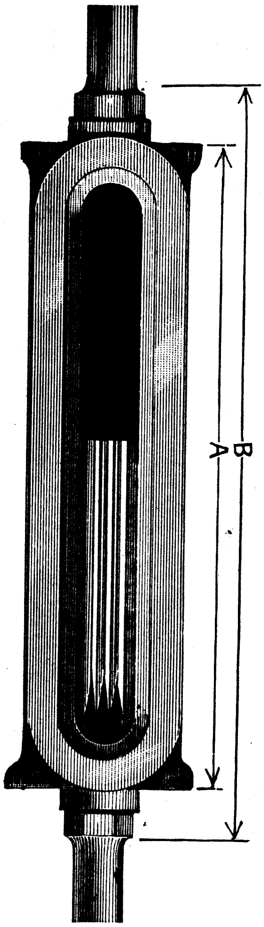

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No.	SIZES — LENGTH A	B	Length of Observ'ti'n Glass
0	4¾"	6¼"	3¼"
1	5¼"	6¾"	3⅞"
2	6¼"	7¾"	4⅞"
3	7¼"	8¾"	5⅞"
4	8¼"	9¾"	6⅞"
5	9⅜"	11"	8"
6	10½"	12"	9¼"
7	11½"	13¾"	10¼"
8	13¼"	14¾"	12'
9	14¼"	15¾"	12½"

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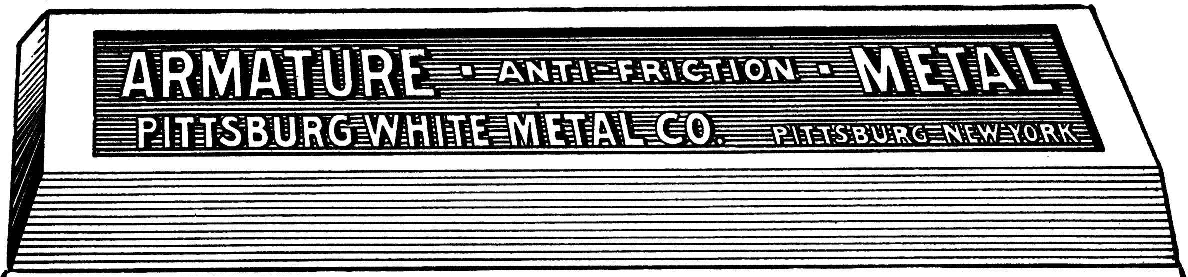

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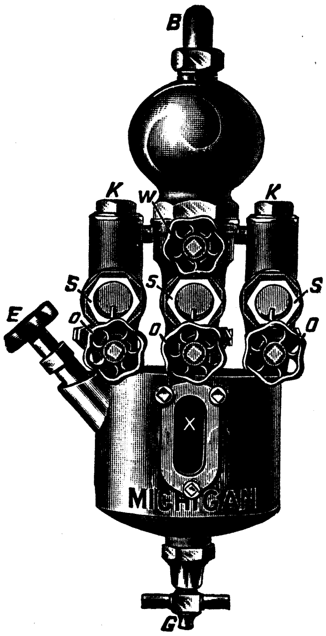

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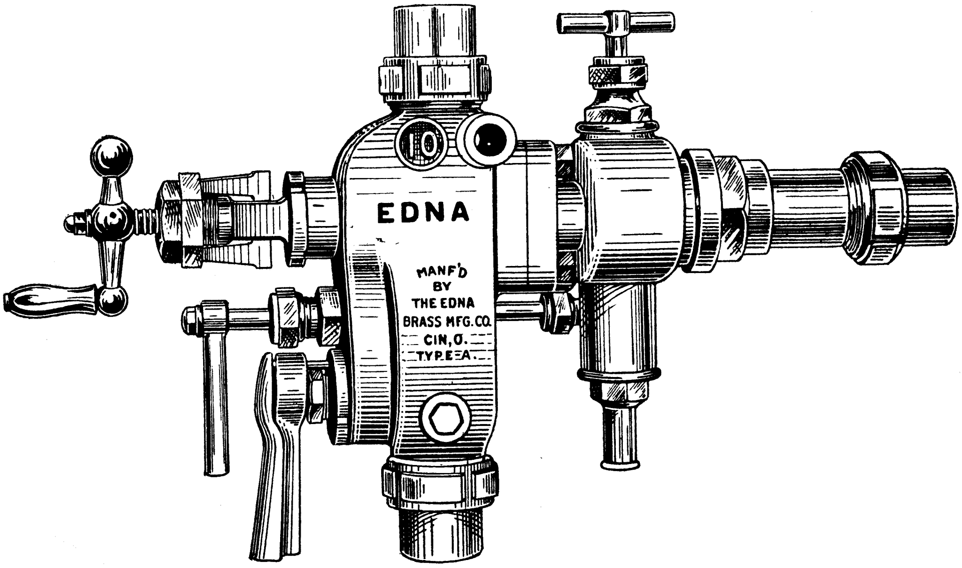

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